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EARTHQUAKES: Scientists link Colo., Okla. temblors to drilling activities

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Scientists are saying with increased certainty that two damaging earthquakes in 2011 -- one in Colorado, the other in Oklahoma -- were triggered by oil and gas production activities.

Studies by seismologists from the U.S. Geological Survey, the University of Oklahoma and Columbia University have found the quakes were caused by the deep underground injection of drilling waste.

The researchers are to present their findings this week at the fall meeting of the American Geophysical Union in San Francisco.

Seismologists have been suspicious from the start that the convulsions were caused by human activity, or "induced." Now, with additional study, they are asserting a connection more definitively.

USGS scientists had been equivocal about links between drilling and chronic seismic activity near Trinidad, Colo., punctuated by a magnitude-5.3 convulsion in August 2011. According to an abstract for this week's conference, they have now concluded that most, if not all, of the quakes "have been triggered by the deep injection of wastewater related to the production of natural gas from the coal-bed methane field here."

University of Oklahoma seismologist Katie Keranen reported earlier this year that there was "a compelling link" between injection and the magnitude-5.6 earthquake in November that injured at least two people and damaged up to 200 structures east of Oklahoma City. Next week, she will present the results of a study done with researchers from USGS and Columbia finding that it was "likely triggered by fluid injection."

But these findings continue to be dismissed as premature by state government scientists in Colorado and Oklahoma and all but ignored by oil and gas regulators (*EnergyWire* , July 25). It's a scientific debate that at times has gotten personal.

"It's still an open question," Colorado state geologist Vince Matthews said in an interview Friday. "These cowboys from USGS are sure these are induced. They're jumping to conclusions."

The findings are part of a slew of reports at the AGU meeting about the connection between drilling waste, hydraulic fracturing and earthquakes. University of Texas scientist Cliff Frolich is to present his findings that injection from Barnett Shale drilling in Texas is causing more earthquakes than previously thought (*EnergyWire* , Aug. 7), and researchers from Columbia's Lamont-Doherty Earth Observatory are to discuss a "swarm" of 82 earthquakes in 2011 in Youngstown, Ohio, that state officials have attributed to waste injection (*EnergyWire* , July 12).

The specific practice of hydraulic fracturing, as opposed to disposal of frack waste, has not been blamed for damaging earthquakes. But researchers from Oxford are to attend the meeting to discuss a magnitude-2.3 earthquake in England attributed to fracturing (*EnergyWire* , May 11).

'We're forced to conclude that these are induced'

Geologists have known for decades that deep injection of industrial waste can lubricate faults and unleash earthquakes. One of the most famous instances of man-made earthquakes, or "induced seismicity," occurred in the late 1960s at the Rocky Mountain Arsenal near Denver, where the Army manufactured chemical weapons.

Earlier this year, USGS scientists released a study saying that a "remarkable increase" in earthquakes in the middle of the country is "almost certainly man-made" and pointed to oil and gas-related activity as a likely culprit. Their findings, though, didn't mention the magnitude-5.3 earthquake in Colorado and specifically excluded the magnitude-5.6 rupture in Oklahoma.

But USGS, prompted by the Colorado earthquake, was re-examining the earthquakes there going back to a "swarm" in 2001. Seismologists at the agency put out a dozen new instruments and then went back into the data they had gathered in the past 10 years and said there is really no other explanation for the earthquakes there.

"They're not consistent with naturally caused earthquakes," said Arthur McGarr, chief of USGS's Branch of Earthquake Geology and Geophysics, based in Menlo Park, Calif. "We're forced to conclude that these are induced."

Matthews, Colorado's top geologist, is unconvinced. He said researchers should wait on more data being gathered by Irving, Texas-based Pioneer Natural Resources, the major driller in the area. He said the company has put 15 seismometers down holes in the area and is getting very precise readings.

"The data that industry is collecting is fascinating," Matthews said. "We've never had precision like that in Colorado before."

But Justin Rubinstein, who worked with McGarr and fellow USGS scientist Bill Ellsworth on the study, said USGS had no guarantee that it would ever be able to review the data and did not need to wait.

"We could have been waiting for nothing," he said Friday.

Waiting for more information

The Oklahoma earthquake, centered near the small city of Prague, would be the largest rupture to be linked to underground injection. But state officials have not concurred with Keranen's findings and are continuing to allow injection above the active Wilzetta Fault, which ruptured in November 2011.

"I don't see the definitive evidence," Austin Holland of the Oklahoma Geological Survey said Friday. "If we're going to claim an earthquake that caused damaged was triggered by human activity, we have to have clear scientific evidence."

The main driller in the area, Tulsa-based New Dominion LLC, says its injection could not have caused the earthquake.

"We feel very comfortable that any injection we're doing had nothing to do with the earthquake," said Jean Antonides, vice president of exploration for New Dominion.

He said the company has a wealth of data about its injection operations in the area that no researchers have asked for.

"You'd think people would ask for it," Antonides said.

Geoffrey Abers, the seismologist at Columbia's Lamont-Doherty Earth Observatory who worked with Keranen on the study, said the team would like more information. Primarily, they would like to get data from instruments placed deep underground, but that hasn't been possible.

Their study concludes that from the timing and proximity of the quake to injection operations, it was likely triggered by injection. The researchers have a wealth of data from surface seismometers because they started placing instruments a day before the earthquake, after a convulsion that proved to be a foreshock.

"Certainly, we'd encourage people trying to understand these things and regulate this to look into monitoring these wells at depth," Abers said.